Dec. 31, 1929. H. D. COLMAN 1,741,757

WARPER AND METHOD OF WARPING YARN

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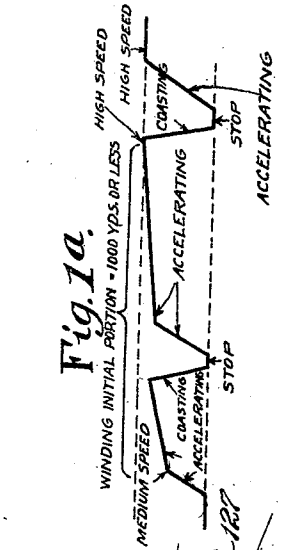


Fig. 1a.

Fig. 1

Fig. 2

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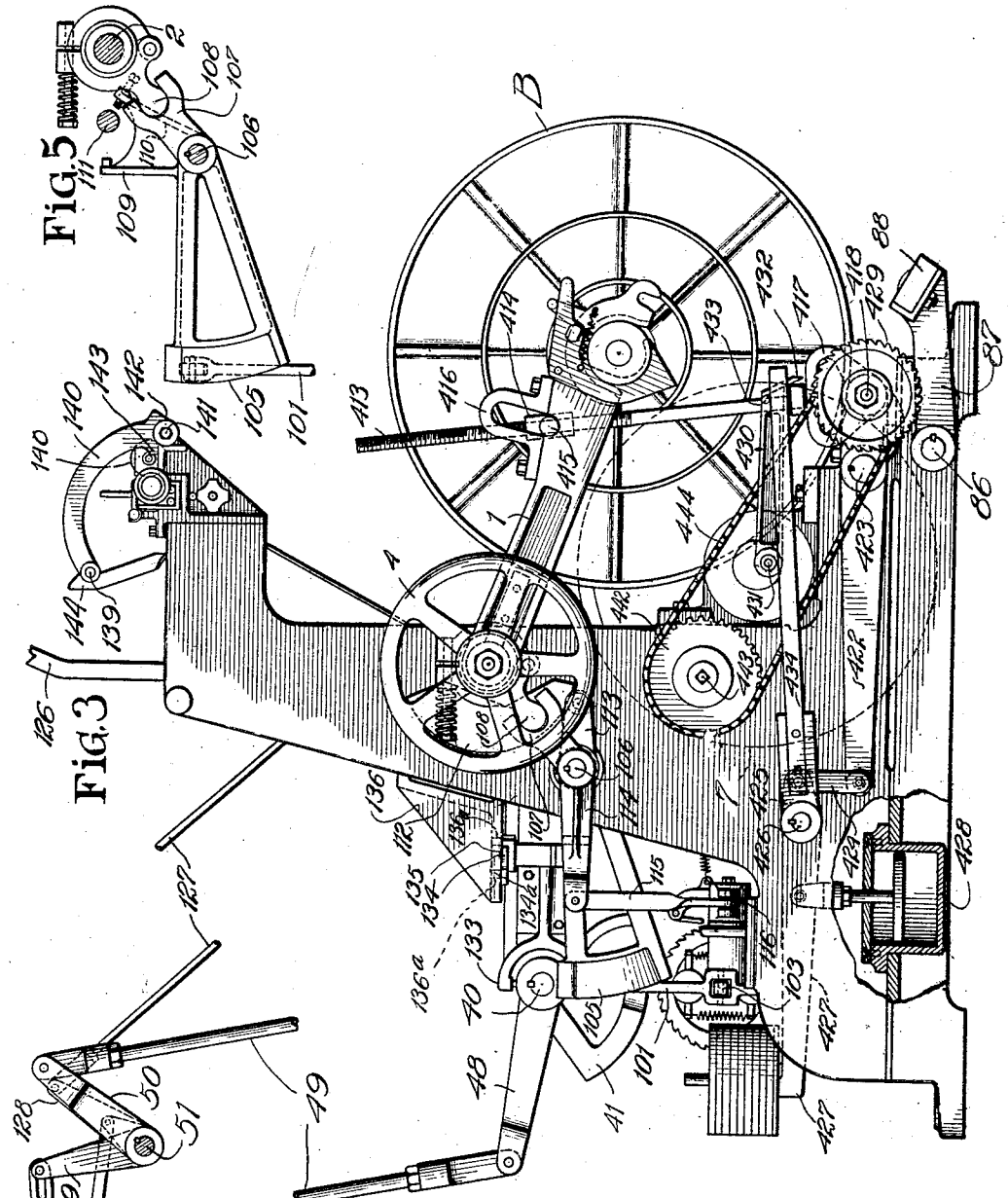


Fig. 5

Fig. 3

Fig. 4

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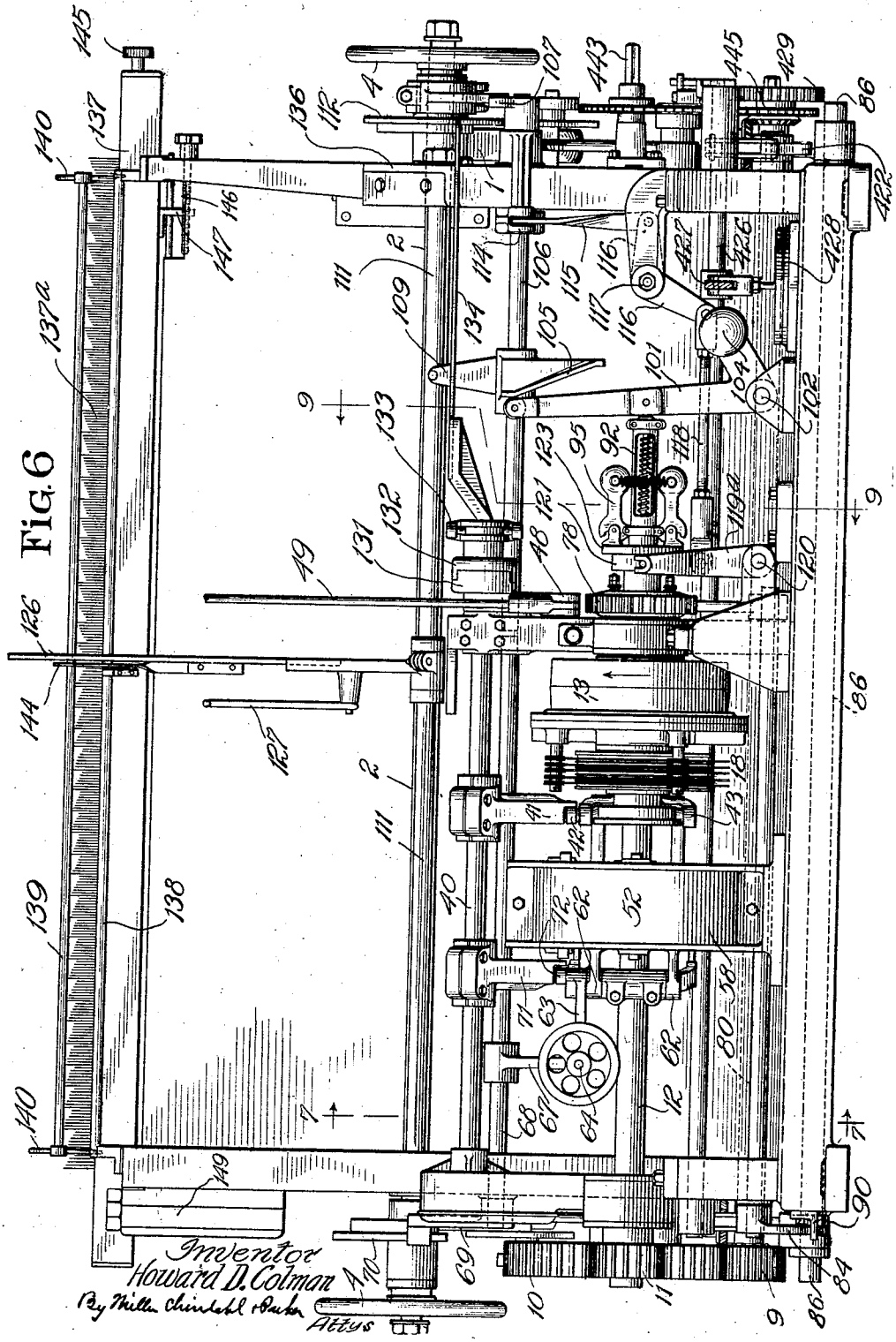


Fig. 6

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WARPER AND METHOD OF WARPING YARN

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Fig. 7

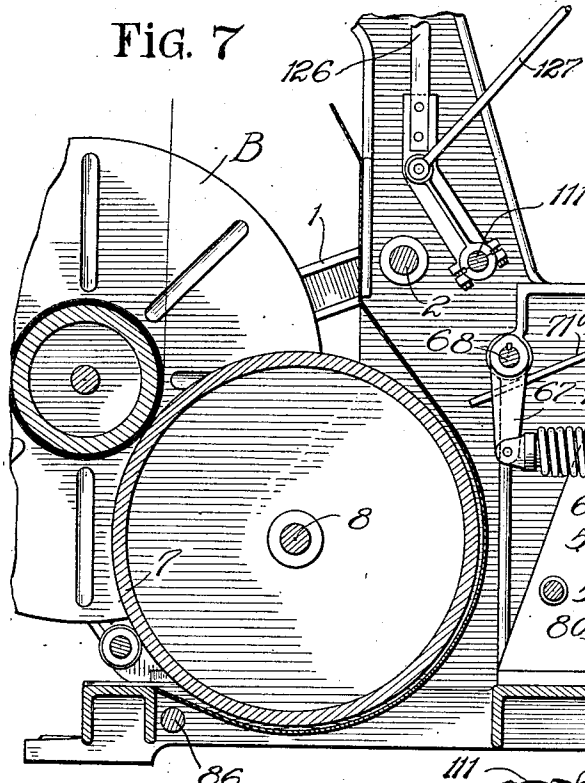


Fig. 8

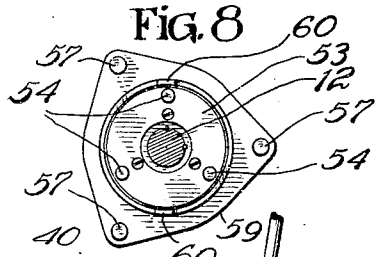
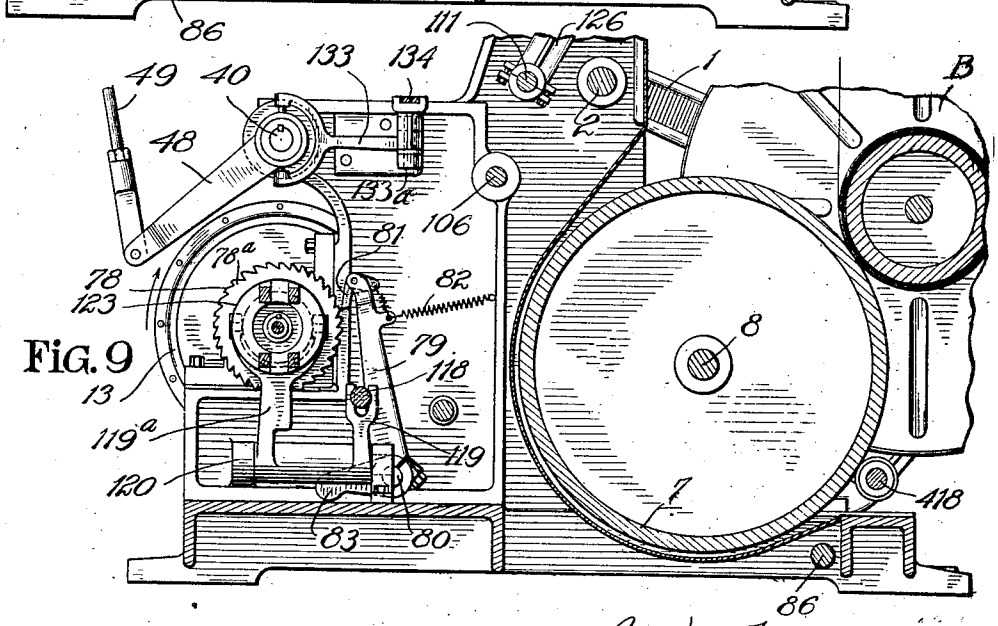


Fig. 9



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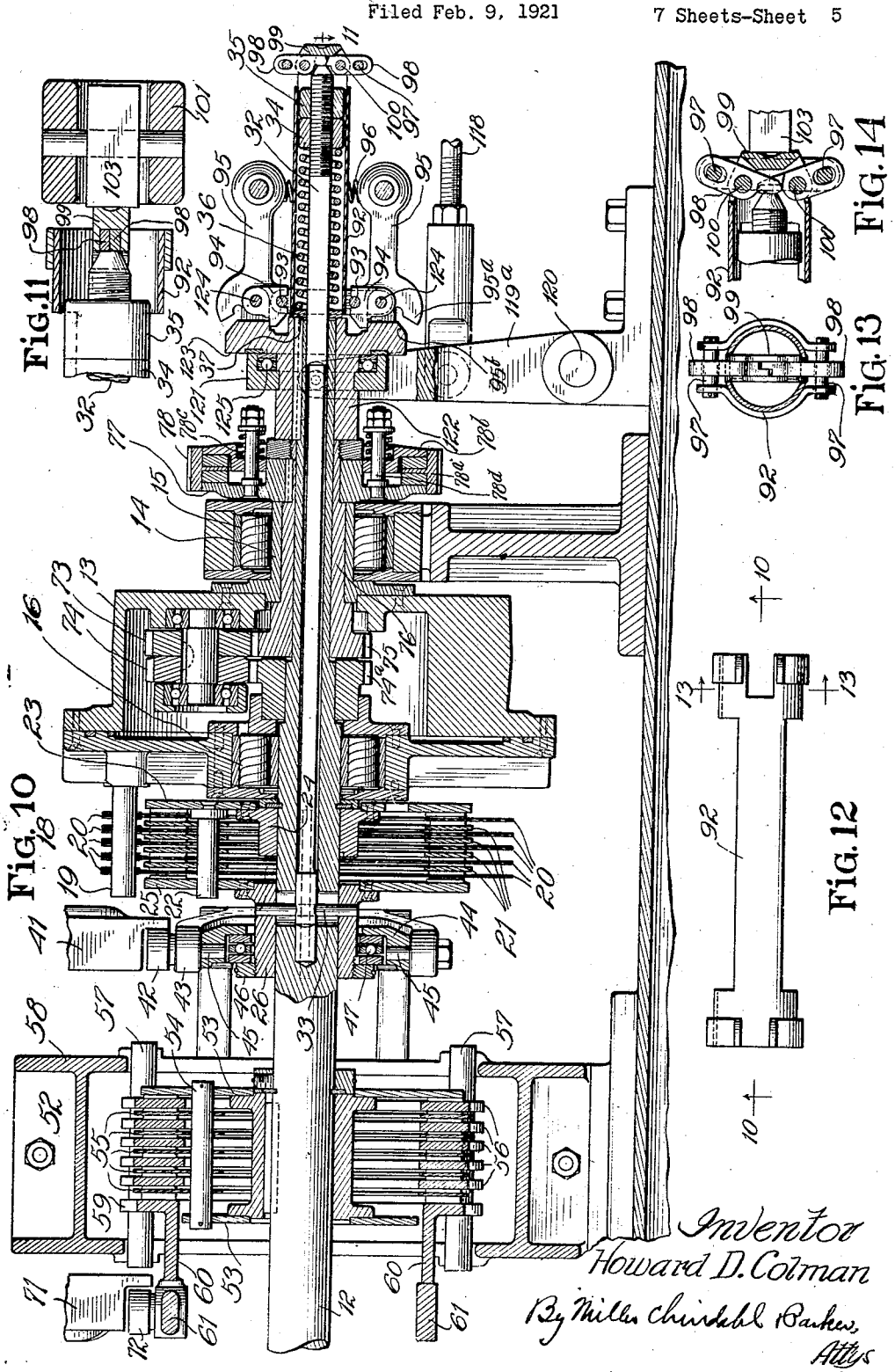


FIG. 10

FIG. 11

FIG. 12

FIG. 13

FIG. 14

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Fig. 15

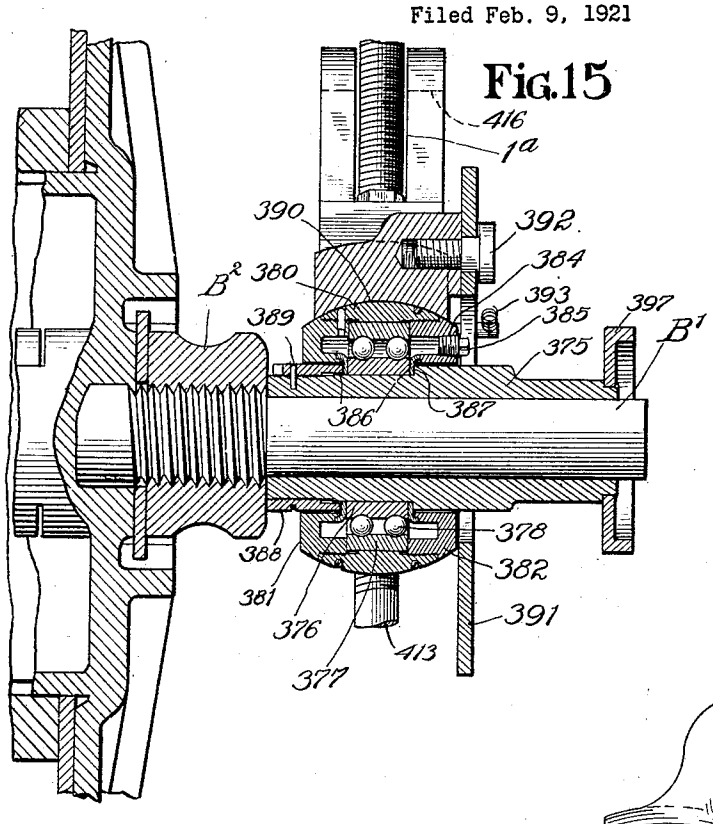
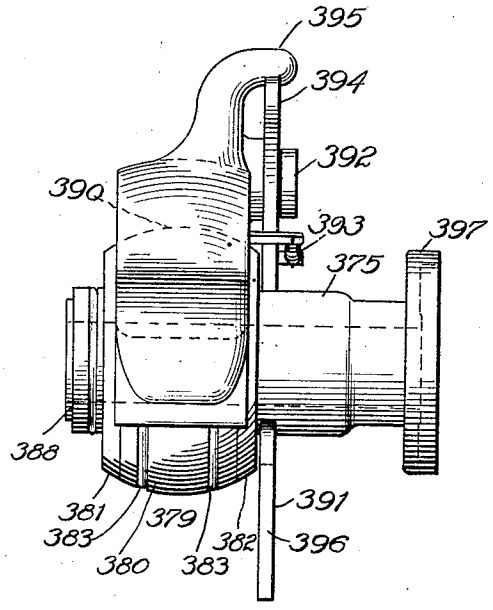


Fig. 16



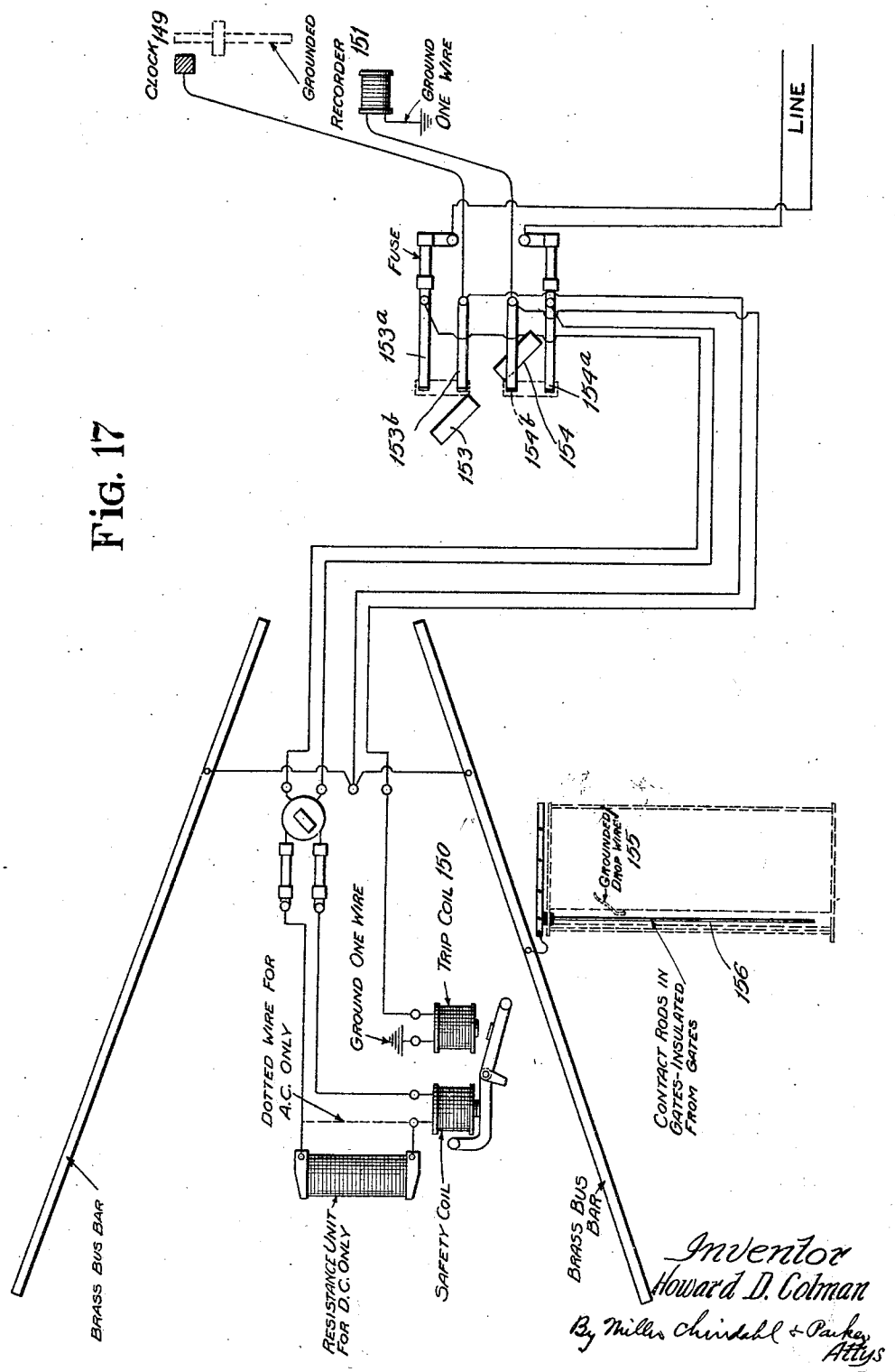
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FIG. 17



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UNITED STATES PATENT OFFICE

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WARPER AND METHOD OF WARPING YARN

Application filed February 9, 1921. Serial No. 443,541.

This invention relates to a machine for winding yarn and the like upon a relatively large container, as, for example, a section beam.

The general object of the invention is to attain a great increase in the winding speed as compared with that employed in the prior art.

Among the obstacles to the use of high speed in warping are those resulting from the necessity of stopping the warper when a thread breaks or becomes unduly slack, when the beam has been filled and when work is to be suspended. It must be possible to stop the rotation of the beam promptly, since otherwise the end of a broken thread would be wound under too far, and the operator would either be unable to find the lost end, or, if found, she would in many cases be unable to tie it up without introducing a crossed thread. It also is necessary to coordinate the coasting of the beam and the coasting of the supply yarn masses in the creel, in order that the threads shall be kept taut and yet not strained to the breaking point, and in order that the tension in the threads shall be approximately the same at all stoppages.

The coasting of the beam equals the coasting of the friction driving drum plus such slippage as may occur between the drum and the yarn mass on the beam. The tendency to slippage is counteracted by the friction between the drum and the yarn mass and by the resistance of the wave produced in the yarn mass by the pressure of the yarn mass against the drum.

All other things being equal, there will be more slippage when there is but little yarn on the beam than after the yarn mass has attained sufficient thickness so that the wave therein can be effective in resisting slippage. Moreover, if, as sometimes happens, the beam trunnions are bent, the resulting tendency toward the formation of an eccentric yarn mass is greatest at the beginning of the warping operation, at which time the means for pressing the yarn mass against the drum is least effective to prevent slippage. It is therefore desirable to wind the initial portion of the yarn mass on the beam (say, the first thousand yards) at a lower speed than that at which the remainder is wound. It is one of the objects of this invention to provide means whereby the initial portion of the yarn mass on the beam shall be wound at such speed that there shall not be sufficient slippage between the yarn mass and the drum to affect the proper coordination of the coasting of the beam and the coasting of the supply yarn masses, the speed being gradually increased until the predetermined maximum speed is attained.

In the present embodiment of the invention, power is transmitted to the friction driving drum through a disk clutch, although any other suitable means providing for slippage during acceleration may be employed. It is one of the objects of this invention to provide means to control the amount of slippage during acceleration. The reason for providing such control will be appreciated when it is stated that if the clutch were adjusted to accelerate properly a beam containing a small amount of yarn, it would be too weak to accelerate properly a beam containing a large amount of yarn. Conversely, if the clutch were made strong enough to accelerate properly a full beam, it would accelerate a beam containing but little yarn so rapidly as to break threads.

A further object of the invention is to provide automatic means for adjusting the beam brake as the momentum of the beam increases and the momentum of the supply yarn masses decreases, in order to maintain the proper coordination of the coasting of the beam and the coasting of the supply yarn masses at each stoppage.

A further object of the invention is to make the control for the low-speed drive entirely distinct from the control for the high-speed drive.

A further object is to locate the driving mechanism in such a position that it shall be out of the way of the operator when she is connecting a new set of supply masses to the beam and when performing other operations about the machine.

The distance between the inner faces of the beam heads varies in different beams.

Moreover, beam heads sometimes become slightly bent. It is therefore an object of this invention to provide means for adjusting the beam lengthwise of the driving drum, so as properly to space the beam heads with reference to the ends of the drum.

Other objects and advantages will become apparent as the description proceeds.

In the accompanying drawings Figure 1 is a right-hand side elevation of a warper embodying the features of my invention, the warper being represented as having just been stopped, the beam brake not having as yet been released. Fig. 1[a] is a diagram illustrating the gradual increase in speed during the winding of the first one thousand yards or so, and the character of the acceleration upon restarting after a stoppage. Fig. 2 is a sectional detail showing the means for adjusting the beam lengthwise of the driving drum. Fig. 3 is a left-hand side elevation of the warper, the parts being in the high-speed position. Fig. 4 is a fragmental view of the operating connection between the warper and the creel. Fig. 5 illustrates a portion of the means for automatically producing a gradual increase in speed as the initial portion of the yarn mass on the beam is being wound. Fig. 6 is a rear elevation, the warper being represented in the same position as in Fig. 1. Fig. 7 is a section on line 7—7 of Fig. 6. Fig. 8 is a detail view of certain parts shown in Fig. 7. Fig. 9 is a section on line 9—9 of Fig. 6. Fig. 10 is a sectional view taken in a vertical plane passing through the drive shaft. (The part 92 is sectioned on the plane 10—10 of Fig. 12.) Fig. 11 is a section on line 11 of Fig. 10. Fig. 12 is a detail view of the part 92. Fig. 13 is a section taken in the plane of line 13—13 of Fig. 12. Fig. 14 is a view taken in the same plane as Fig. 10, but showing the parts in a position which they may assume when the warper is running and the initial portion of the beam is being wound at reduced speed. Figs. 15 and 16 illustrate the connection between the beam and the beam-arms. Fig. 17 is a diagram of the electric circuits.

The embodiment herein shown of my invention is especially adapted for use with a creel of the general character disclosed in my application Serial No. 190,501, filed September 10, 1917. (Now Patent No. 1,544,055, dated June 30, 1925.) It will be understood, however, that various features of the present invention are independent of the creel and independent of other features of the warper.

Referring now to the drawings: B denotes a section beam the trunnions of which are engaged by arms 1.

The arms 1 are pivotally mounted upon a shaft or rod 2 extending through the main frame of the warper. Means is provided for shifting the arms 1 lengthwise of the rod 2 in order to bring the inner faces of the heads of the beam B into proper relation to the ends of the friction driving drum. Any suitable means may be employed for thus adjusting the arms 1. Herein each end of the rod 2 is screw-threaded, as indicated in Fig. 2, and carries a nut 3 forming part of the hand wheel 4. In the nut 3 is a peripheral groove 5 that receives the end of a bracket 6 attached to the arm 1. The inner side of the nut 3 lies in contact with the hub of the arm 1. It will be seen that as the hand wheel 4 is turned, the arm 1 will be moved longitudinally of the rod 2. To hold the hand wheel in adjusted position, any suitable means may be used, as, for example, a spring pressed plunger 4[a] carried by the hub of the arm 1 and adapted to enter any one of a series of recesses 4[b] in the hub of the hand wheel.

The yarn wound around the beam B rests upon a friction driving drum 7. Said drum is fixed upon a shaft 8 which is journaled in the warper framework and carries at one end a spur gear wheel 9 that meshes with a similar gear wheel 10 rotatably supported on the frame. The gear wheel 10 in turn meshes with a pinion 11 fixed upon a drive shaft 12 which is supported in the rear portion of the framework.

The means for driving the shaft 12 comprises a pulley or drum 13 (Fig. 10) intended to be continuously driven by a belt (not shown). The drum 13 is provided at one side with a hub or sleeve 14 which is supported in a roller bearing 15 carried by the machine frame. At its other side the drum 13 is supported on a roller bearing 16 on the shaft 12. Power is transmitted from the drum 13 to the shaft 12 by suitable means, as for example, a clutch 18 of the multiple disk type. In the present construction the drum 13 carries a suitable number of posts 19 upon which are slidably mounted disks or rings 20 which alternate with disks or rings 21 carried upon posts 22 attached to a flange 23. Said flange is fixed to a sleeve 24 which is fast upon the shaft 12. The posts 22 extend slidably through openings in a flange or pressure plate 25 which is fixed to a sleeve 26 that is slidable longitudinally of the shaft 12. The means for clamping the disks together comprises a rod 32 extending axially of the shaft 12 and having near its inner end a transverse pin 33 the ends of which extend through slots in the shaft 12 and into openings in the sleeve 26. The outer end of the rod 32 is screw-threaded to receive an adjusting nut 34 and a lock nut 35. A coiled expansion spring 36 is interposed between the nut 34 and a washer 37 and tends to move the rod 32 in the direction to throw in the clutch. It will be seen that when the clutch is thrown in, power will be transmitted from the drum 13 through the clutch 18 to the shaft 12 to rotate the beam B at high speed.

The means for throwing the high speed drive in and out of action comprises a rock shaft 40 (Fig. 6) supported in the warper framework and having fixed thereto a segmental cam 41 against which bears a roller stud 42 on a yoke or fork 43 which is pivotally supported in the framework. A ring 44 (Fig. 10) is pivotally supported in the fork 43 upon the pivot pins 45. On the sleeve 26 is a collar 46 between which and the ring 44 a thrust bearing 47 is interposed. The means for turning the shaft 40 comprises an arm 48 (Fig. 3) connected to said shaft in a manner to be hereinafter described. The arm 48 may be operated by any suitable means, as, for example, the means disclosed in my Patent No. 1,544,055. The means shown in said application includes a rod 49 connecting the arm 48 to a crank arm 50 which is fixed upon a rock shaft 51. The shaft 51 is connected to a suitable brake-applying and resetting mechanism. When said mechanism is actuated through the exhaustion or excessive slackening of a thread, the shaft 40 is turned in the direction to cause the cam 41 to move the pressure plate 25 away from the plate 23, thereby throwing out the clutch 18.

A brake is provided to cause prompt stoppage of the beam when exhaustion or excessive slackening of a thread occurs. While the brake may be of any suitable construction, there is herein shown a brake 52 (Fig. 10) of the disk clutch type and comprising flanges 53 attached to the shaft 12 and carrying posts 54 on which disks or rings 55 are slidably mounted. These disks alternate with disks 56 carried by posts 57 in a housing 58 fixed to the warper framework. The disks 55 and 56 are arranged to be pressed together by means including a ring or pressure plate 59 slidably mounted on the posts 57 and having lugs 60 that are engaged by a fork 61 (Fig. 7) which is pivoted at 62 (Fig. 6) on the brake housing 58. Rigid with the fork 61 is a crank arm 63 having an eye through which a rod 64 (Fig. 7) extends sildably. A nut 65 on the rod 64 provides means for adjusting the tension of a coiled contractile spring 66 which is connected at one end to the rod 64 and at its other end to a crank arm 67 fixed on a rock shaft 68. To one end of the shaft 68 is fixed an arm 69 (Fig. 1) carrying a roller stud that lies against a cam flange 70 on the adjacent arm 1.

Inasmuch as the beam B is driven through peripheral contact of the yarn mass with the friction drum 7, its speed of rotation will decrease as the beam fills. The mass of the yarn load on the beam, of course, increases as the beam fills. The net result of the decreasing speed and the increasing mass will be an increase or a decrease in momentum dependent upon the amount and distribution of the mass in the beam, its yarn load and the rotating machine elements. In the construction herein illustrated, the momentum of the beam may be considered to increase as the beam fills. On this assumption it is desirable to provide means for adjusting the beam brake to make the same more powerful as the beam fills. If the momentum of the supply yarn masses be assumed to decrease as they are unwound, they will coast less at each succeeding stop. It is therefore desirable that the coasting of the beam shall be diminished at each succeeding stop. These results are attained by the cam 70 and its connections to the spring 66. As the yarn mass on the beam grows, the beam and the arms 1 rise, the cam 70 operating to cause the arm 67 to swing in the direction to increase the tension of the spring 66 thereby causing a stronger application of the beam brake at each successive stoppage.

While the means for applying and releasing the brake 52 may be of any preferred character, that herein shown consists of a segmental cam 71 fixed upon the shaft 40 and engaging a roller stud 72 on the fork 61. When the shaft 40 turns in the direction to throw out the clutch 18 the cam 71 allows the fork 61 to move, under the action of the spring 66, in the direction to apply the brake. In case the shaft 40 should be accidentally permitted to turn slightly beyond the normal declutching and braking position, further movement of the shaft is prevented by the contact of a safety stop 71^a on the cam 71 with a collar on the shaft 68.

After the creel mechanism has operated to stop the warper, it is desirable to be able to revolve the beam slowly in finding the thread end on the beam and preparatory to restarting the winding operation. In order that the beam may be rotated at low speed, there is provided the mechanism to be now described, although various other constructions may be employed, if desired.

The drum 13 rotatably supports two pinions 73 and 74 (Fig. 10), the pinion 74 being of slightly smaller diameter than the pinion 73. Said pinions are rigidly connected together. The pinion 74 meshes with a pinion 74^a fixed on the shaft 12. The pinion 73 meshes with a pinion 75 attached to or formed upon a sleeve 76 which is rotatably mounted upon the shaft 12 and lies within the hub 14. The drum 13 is intended to contain a suitable quantity of lubricant. Means under the control of the operator is provided for holding the pinion 75 against turning movement. In the present embodiment said means comprises a wheel or flange 77 rigid with the sleeve 76 and having a series of ratchet teeth 78 connected thereto in such a manner as to be capable of yielding with relation to the flange 77. Herein the teeth 78 are shown as formed on a ring 78^a which is yieldingly clamped to the flange 77 by means of a disk 78^b and expansion springs 78^c, said springs

being mounted on posts 78^d fixed to the flange 77.

An arm 79 (Fig. 9) fixed upon a rock shaft 80 carries a spring-pressed pawl 81 which is adapted to engage the ratchet teeth 78. A coiled contractile spring 82 tends to swing the arm 79 in the direction to remove the pawl 81 from the ratchet teeth 78. 83 is a stop lug on the arm 79 arranged to engage the framework and thus limit movement of the arm 79 toward the ratchet wheel. On the opposite end of the shaft 80 is fixed an arm 84 (Fig. 1) which has a pin-and-slot connection with an arm 85 which is fixed upon one end of a rock shaft 86 supported in the warper framework. Rigid with the arm 85 is an arm 87. There is a similar arm 87 at the opposite end of the shaft 86 (Fig. 3). The arms 87 carry a cross bar 88, thus providing a treadle extending across the front of the warper beneath the beam by means of which the operator may throw the pawl 81 into engagement with the teeth 78.

The inertia of the beam and the mechanism extending from the beam to the pinion 74^a is of course greater than that of the pinion 75, sleeve 76 and ratchet wheel 77; consequently when the beam is at rest, the continuing rotation of the drive pulley 13 causes the pinion 74 to roll around the pinion 74^a, thus causing the pinion 73 to rotate. By reason of the difference in the diameters of the pinions 73 and 74, the pinion 75 and the ratchet wheel 77 are slowly rotated in the direction opposite to the direction of rotation of the drive pulley. If now the operator depresses the treadle, the pawl 81 will engage and hold the ratchet wheel 77 (and consequently the pinion 75) against rotation, thus causing the pinion 74^a to rotate, whereby the warp beam is slowly revolved. When the operator has found the thread end, she removes her foot from the treadle, whereupon the weights 89 and the spring 82 throw out the low-speed drive. After having pieced up the thread, the operator may again depress the treadle to turn the beam at low speed until the slack in the pieced-up thread has been taken up and all of the threads are seen to be running properly.

The reason for providing a yielding connection between the ratchet wheel 77 and its teeth 78 is to permit of setting the beam in rotation without excessive shock.

For reasons hereinbefore stated, means is provided whereby the drum 7 is rotated at less than maximum speed during the winding of the initial portion of the yarn mass on the beam. While any suitable means may be employed to provide such reduced speed, in the present embodiment the reduction in speed is obtained by slippage of the clutch 18, such slippage being controlled by a centrifugal governor. The change from reduced speed to high speed is a gradual one and is controlled by devices sensitive to increase in the diameter of the yarn mass on the beam.

Referring now to Figs. 10 to 14: A frame 92 surrounds the spring 36 and is movable longitudinally of the rod 32. On one end of the frame 92 are pins 93 that engage notched arms 94 of two bell-crank levers 95, the other arms of which are weighted and connected together by coiled contractile springs 96. The governor arms 95 are carried by an element that revolves with the shaft 12. The other end of the frame 92 is provided with pins 97 on which are loosely mounted two levers 98 extending toward each other. The adjacent ends of the levers 98 are adapted to bear against the end of the rod 32. An abutment 99 is pivoted to the levers 98 at 100.

A lever 101 (Fig. 6) pivoted to the machine frame at 102 carries a pivoted block 103 (Figs. 11 and 14) arranged to bear against the abutment 99. A weight 104 (Fig. 6) holds the lever 101 in contact with a cam 105 fixed upon a rock shaft 106. Mounted on the shaft 106 is a forked arm 107 (Figs. 3 and 6) that engages an arm 108 which is yieldably clamped on the hub of the adjacent arm 1, as shown in Fig. 5.

When a new beam is being started, the cam 105 stands in its lowermost position, holding the lever 101 in such position that the block 103 is pressed against the abutment 99. The position in which the abutment 99 is held is such as will enable the governor, acting through the levers 98 and the rod 32, to produce sufficient slippage of the clutch 18 so that the speed shall not be great enough to cause excessive slippage between the beam and the drum 7 in case the brake 52 be applied. The governor tends to keep the speed uniform by shifting the frame 92. When the speed rises, the shifting of the frame 92 to the right (Fig. 14) causes the levers 98 to force the rod 32 to the left, thus decreasing the pressure on the clutch 18. When the speed falls, the levers 98 are moved by the governor in the direction to allow the spring 36 to exert more pressure on the clutch.

As the yarn mass increases in diameter, the cam 105 rises and allows the block 103 to move to the right (Fig. 14), thereby allowing the spring 36 to place more pressure on the clutch, and thus increasing the winding speed. When the block 103 leaves the abutment 99 (which occurs when the necessity for winding at reduced speed has passed), the centrifugal governor is ineffective to control the spring 36. Outward movement of the governor arms 95 is limited by contact of the stop lugs 95^a on said arms with surfaces 95^b on the element that carries the governor arms.

The diameter of the beam barrel varies in different beams, and consequently the lowermost or starting position of the arms 1 will vary. If the starting position of the cam 105

were determined solely by the starting position of the adjacent arm 1, the thickness of yarn wound at reduced speed would be less on beams having larger barrels than on beams having smaller barrels. I therefore provide means for insuring that the same thickness of yarn shall be wound at the reduced speed irrespective of variations in the diameters of beam barrels. This means comprises stop arms 109 and 110 (Fig. 5) fixed to the cam 105 and arranged to engage a suitable stationary part, as, for example, a rod 111 fixed in the framework. As hereinbefore stated, the arm 108 is yieldably connected to the arm 1, thus allowing for continuing downward movement of the arm 1 after the cam 105 has reached its starting position, and for continuing upward movement of the arm 1 after the stop 109 engages the rod 111. The stop arms 109 and 110 serve to determine the final and initial positions, respectively, of the cam 105.

In the present embodiment of the invention, the pressure exerted by the spring 36 is arranged to be controlled in accordance with the size of the yarn mass, the range of load on the clutch being too great without such control. If the clutch were adjusted to accelerate a small yarn mass properly it would be too weak to accelerate properly a beam which was nearly full; and if made strong enough to accelerate with the desired rapidity a beam which was nearly full it would accelerate a small yarn mass so rapidly as to break threads. The means herein shown for adjusting the springs to insure proper acceleration comprises a cam 112 (Fig. 3) fixed upon the hub of one of the arms 1 and operating against the arm 113 of a lever 114 loosely mounted on the shaft 106. Said lever is connected by a link 115 to one arm of a bell crank lever 116 pivoted at 117. The other arm of said bell crank lever is connected by a rod 118 (Fig. 6) to an arm 119 (Fig. 9) which is rigid with a forked lever 119[a] pivoted at 120. The forked end of the lever 119[a] engages a collar 121 that loosely encircles a sleeve 122 which is splined upon the shaft 12. A disk or flange 123 rigid with the sleeve 122 carries pivots 124 (Fig. 10) for the governor arms 95. A thrust bearing 125 is interposed between the collar 121 and the disk 123. The sleeve 122 is arranged to engage the washer 37. It will be seen that as the yarn mass increases in diameter, the cam 112 will be turned, the contour of the cam being such as to cause the spring 36 to be placed under additional compression in the desired degree and at the desired stages of operation.

To start the warper at the intermediate or higher speed, the operator draws forward a hand lever 126 which is fulcrumed on the rod 111 (Fig. 7) midway of the length of the warper, said lever extending upwardly through the space between the two sets of threads coming from the opposite sides of the creel. To said lever is pivoted the lower end of a link 127, the upper end of which is connected to one arm of a crank arm 128 (Fig. 4) loosely mounted on the shaft 51. The arm 128 is rigid with a crank arm 129 which is connected to a rod 130 that extends to the resetting mechanism hereinbefore referred to. Thereupon said resetting mechanism causes the arm 48 to be raised, thereby turning the segment cams 41 and 71, and effecting the release of the brake 52 and the throwing in of the clutch 18.

It sometimes is desirable to operate the hand lever 126 to start the resetting mechanism without releasing the brake and without throwing in the high-speed drive. Means is therefore provided for disconnecting the arm 48 from the shaft 40. This means is shown in Figs. 6 and 9. The arm 48 is fulcrumed on the shaft 40 and has a clutch hub 131 (Fig. 6) adapted to be engaged by a clutch member 132 splined on said shaft. A forked arm 133 pivoted at 133[a] has pins entering a peripheral groove in the clutch member 132. Rigid with the arm 133 is a hand lever 134 extending to one end of the warper. When it is desired to place the resetting mechanism in operation without releasing the beam brake or causing the driving mechanism to be connected to the shaft 12, the operator employs the hand lever 134 to disconnect the arm 48 from the shaft 40 before pulling the hand lever 126 forward. The hand lever 134 underlies a plane surface 135 on a bracket 136 attached to the machine frame. In this surface are two holes 136[a] adapted to receive a locking pin 134[a] on the hand lever 134, thus providing means for holding the clutch member 132 in or out of operative position.

The threads extending from the creel to the beam may be guided in any suitable manner. Herein they are shown as running through a comb 137 (Fig. 6) located on the warper frame, there being a guide rod 138 behind the comb to hold the lower strands out of contact with the back or body of the comb. If desired, a rod 139 may be provided above the rod 138 to keep the upper strands in the comb. The rod 139 is herein shown as carried by two arms 140 pivoted to the end members of the warper frame at 141. Stop surfaces 142 on the arms 140 engage with suitable fixed parts to limit the forward swing of the arms. A stop lug 143 (Fig. 3) on one of the arms 140 serves to limit movement of said arms in the opposite direction. The rod 139 is held in operative position by suitable means such as a spring latch 144 on the warper frame engaging the middle portion of the rod.

While any ordinary form of comb may be used on the warper, it is preferable to employ a comb the teeth or spaces of which are

so arranged as to indicate the proper locations for the respective threads. As shown in Fig. 6, the teeth 137[a] of the comb 137 are divided into sections, there being as many sections as there are columns of cheeses in the creel, and each section containing as many spaces as there are cheeses in a column. The sections are differentiated from each other by making the teeth of each section of regularly increasing length, the shortest tooth being at the inner end of the section. The space between the two middle sections is made slightly wider than the other spaces, as such middle space receives two threads. The method of placing the threads in the comb is described in my copending application Serial No. 190,501.

The comb may, if desired, and as herein shown, be of the expansion type, the comb being expanded by operation of the hand wheel 145.

The comb is adjustable longitudinally of the beam by means of a screw 146 (Fig. 6) mounted in the warper frame and engaging a nut 147 attached to the comb.

Forward of the comb is a measuring roll 148 suitably connected to drive a warper clock 149. The clock may be of any suitable construction, being preferably arranged to close an electric circuit (see Fig. 17) containing an electromagnet or trip coil 150 that controls the means for stopping the warper, in order to stop the warper when the desired amount of yarn has been wound upon the beam. (The electromagnet 150 corresponds to the electromagnet 44, the action of which is fully described in my Patent No. 1,544,055.) If desired, an electromagnetically-actuated recorder 151 (Fig. 17) of any suitable type may be employed to record stoppages.

A switch 152 (Figs. 1 and 17) controls the circuits of the clock 149, the trip coil 150, the recorder 151 and the detectors on the creel. The movable contact members 153 and 154 of said switch are attached to but insulated from the shaft 40, and are arranged to bridge contact fingers 153[a] 153[b] and 154[a] 154[b] included in the circuits as shown in Fig. 17. When the warper is stopped, the turning of the shaft 40 opens the switch 152, thus interrupting the flow of current to ground through the fallen detector 155 or the clock 149, as the case may be, the trip coil 150, and the recorder 151. When the warper is restarted at high speed, the turning of the shaft 40 closes the switch 152, the detector circuits having, of course, been previously opened by the raising of the detectors by slow rotation of the beam, and the clock having been adjusted to initial position, if the stoppage was due to completion of the beam.

It may be here stated that the warper and the creel are both grounded and are electrically connected together through the steel operating links 49 and 127. The drop wires or detectors 155 on the creel are grounded, and when released by slack or broken threads they make contact with contact rods 156. One of the detectors 155 is shown in Fig. 17.

Referring now to the means for connecting the beam to the arms 1: While this means may be of any suitable character, I have herein shown the devices illustrated in Figs. 15 and 16. A sleeve 375 is adapted to be slid upon the trunnion B′ of the beam. On the sleeve 375 is mounted a ball bearing consisting of an inner ball race 376 fast on the sleeve, an outer ball race 377, bearing balls 378 and an enclosing casing 379. The latter consists of three annular sections 380, 381 and 382 having screw-thread connection with one another. Said sections are locked against rotation with relation to each other by means of two spring clips 383 lying within grooves in the outer surface of the section 380 and having inturned ends that enter openings in the sections 381 and 382. The sections 381 and 382 are chambered to provide space for lubricant, 384 being an opening through which lubricant may be introduced. 385 is a plug for closing said opening. The sections 381 and 382 have inwardly extending annular flanges 386 which lie at opposite sides of the inner ball race 376. The flanges 386 lie between an annular shoulder 387 on the sleeve 375 and a collar 388 screwed on the sleeve and held against rotation on the sleeve by a spring clip or nut lock 389.

As the trunnions of a beam are sometimes bent out of alinement with each other, it is desirable to provide a self-alining connection between the trunnions and the arms 1. The outer surface of the casing 379 is therefore made spherical in order that it may have a swivelling or wobbling motion within a socket 390 in the lower side of the arm 1. A latch 391 is pivoted to each arm 1 at 392, the lower hooked end of said latch being normally held in place beneath the sleeve 375 by means of a coiled spring 393. The latch is provided with a handle 394. The normal position of the latch is determined by contact of said handle with a stop 395 on the arm 1. The lower end of the latch has a beveled edge 396 so that upon relative approaching movement between the arm 1 and the sleeve 375 the latch shall be pushed aside to allow the casing 379 to enter the socket 390. On the outer end of the sleeve 375 is a flange or collar 397 constituting a handle.

It will be seen that the sleeve 375 and the roller bearing form a unitary bearing structure adapted to be placed upon the beam trunnion to permit of a high rate of rotation of the beam and such swivelling movement as may be necessitated by non-alinement of the trunnions.

Any suitable means may be employed to counteract any tendency that may be operat-

ing to make the yarn mass on the beam B eccentric or tapering. The means herein shown for that purpose comprises two screw rods 413, each extending through a slot 1ª (Fig. 15) in one of the arms 1. On each screw rod 413 is a nut 414 having diametrically opposite studs 415 that lie in elongated openings 416 in the arm. The screw rod 413 is rotatably mounted in a yoke or coupling member 417 which is pivotally mounted upon a shaft 418 extending from side to side of the warper. The screw rod 413 is intermittently rotated to allow the arm 1 to rise as the beam fills by means including a bevel gear 419 secured to the lower end of the screw rod said bevel gear meshing with a similar gear 420 which is fixed upon the shaft 418. It will be seen that the shaft 418 causes the screw rods 413 at the opposite sides of the warper to rotate simultaneously. The rods 413 rotate in opposite directions, one rod having a right-hand thread and the other a left-hand thread.

The shaft 418 is rotatably mounted in bearings in the forward end of two levers 422, said levers being pivoted to the framework at 423. The rear ends of the levers 422 are connected by means of links 424 to crank arms 425 fixed upon a rock shaft 426. Rigid with the last-mentioned shaft is a weighted arm 427 that causes a downward pull to be exerted upon the screw rods 413. Any suitable means may be provided to damp the vibrations of the weighted arm 427, as, for example, a dash pot 428, the plunger of which is connected to said weighted arm.

The shaft 418 is rotated in the direction to cause the nuts 414 to travel upwardly on the screw rods 413 by means comprising a ratchet wheel 429 fixed on said shaft. A connecting rod or pitman 430 is mounted upon a crank pin 431 attached to the shaft of the friction drum 7. Upon the forward end of the pitman 430 is fixed a hardened plate 432 which is adapted to engage the teeth of the ratchet wheel 429. The pitman 430 with its plate 432 virtually constitute a pawl. Attached to the pitman 430 is a pin 433 that rests upon an arm 434 which is fixed to the shaft 426. In operation, the weighted arm 427 acting through the shaft 426, the crank arms 425, the links 424, the levers 422, the yokes 417, the screw rods 413, the nuts 414, the studs 415 and the arms 1, presses the yarn mass on the beam tightly and practically unyieldingly against the drum 7. Any tendency operating to make the yarn mass eccentric is continually being resisted. To illustrate: If the yarn mass were to become slightly eccentric, the high portion in passing between the axes of the beam and the drum would tend to force the arms 1 to swing away from the drum against the downward pull exerted through the screw rods 413; but by reason of the dash pot 428 and the inertia of the parts, the arms 1 would not yield to such upward pressure, and consequently the high portion would be rolled down and the yarn mass restored to cylindrical form. As the yarn mass increases in diameter the arms 1 are forced upwardly, thus lifting the screw rods 413 and causing the levers 422 to turn, the rear ends of said levers moving downwardly. As said levers are connected with the crank arms 425 and the latter in turn are rigid with the arm 434, the forward end of the latter arm moves downwardly. When said arm 434 is swung downwardly so far as to allow the pawl 432 to engage the ratchet wheel 429, said wheel is turned through the distance of one or more teeth. The screw rods 413 are thereby turned through a partial revolution in the direction to lower said rods. Such rotation of the screw rods 413 allows the weighted arm 427 to descend, thereby raising the arm 434 and causing the pawl 432 to be lifted away from the ratchet wheel. The mechanism thus operates intermittently to adjust the connection between the arms 1 and the pressure-applying means as the yarn mass increases in diameter. Inasmuch as the shaft 418 transmits an equal amount of rotation to the screw rods 413, and the shaft 426 causes equal movement of the levers 422, the upward movements of the opposite ends of the beam are parallel, and thus the formation of a tapering yarn mass is prevented.

When the beam is to be removed from the warper the arms 1 must be raised sufficiently to permit of the disengagement of the roller-bearing casings 379 from the arms 1. After an empty beam has been connected to the arms 1, said arms must be lowered to place the beam upon the drum 7. It is therefore desirable to provide means for manually rotating the screw rods 413 to raise and lower the arms 1. The means herein shown for this purpose comprises a sprocket wheel 442 rotatably mounted upon one end frame of the warper and having a crank-receiving stud 443. A chain 444 extends from the wheel 442 to a wheel 445 (Fig. 6) which is rigid with the shaft 418. Rotation of the wheel 442 obviously will raise or lower the arms 1.

Assuming the parts to be in the position shown in Fig. 1, the warper having been stopped through the action of a detector, the operation is as follows: The resetting mechanism on the creel turns the shaft 40 far enough to release the beam brake 52 and place a drag pressure on the cheeses in the creel, but not far enough to throw in the driving clutch 18. The operator then finds the thread-end on the beam and pieces up the broken threads. To facilitate the finding of the end on the beam, the operator may set the beam in slow rotation by depressing the treadle 88. After having pieced up the

thread the operator may again depress the treadle to turn the beam at low speed until the slack in the pieced-up thread has been taken up and all of the threads are observed to be running properly. The apparatus is now ready to be operated at high speed. To remove the drag pressure from the cheeses and to throw in the high-speed drive, the operator draws forward the hand lever 126. The resetting mechanism on the creel thereupon removes the drag pressure from the cheeses and turns the shaft 40 into the position shown in Fig. 3, in which position the cam 41 releases the driving clutch 18 to the action of the spring 36. Said clutch then commences to accelerate the beam.

As the yarn mass on the beam grows, the cam 105 allows the spring 36 to place more pressure on the driving clutch 18, thus gradually increasing the speed, the acceleration being controlled by the governor 95. The action of the governor and the cam 105 is illustrated in the diagram entitled Fig. 1ª. Maximum speed will be attained by the time such a thickness of yarn has been wound on the beam so that excessive slippage between the yarn mass and the driving drum will not occur at a stoppage.

As the beam fills, the brake-actuating spring 66 is adjusted by the cam 70 so as to cause a stronger application of the brake 52 at each succeeding stop.

When the beam has been filled, the clock 149 closes a circuit that causes the strip coil 150 to be energized, whereupon the creel brakes are applied and the shaft 40 turned to apply the beam brake 52 and throw out the driving clutch 18. The resetting mechanism on the creel also begins to operate to release the beam brake and substitute the drag pressure for the brake pressure on the cheeses. The beam may then be disconnected from the cheeses in any suitable way. If desirable, the cheeses may be held against rotation during the operation of disconnecting the beam from the cheeses by employing means such as that described in application Serial No. 190,501 for applying the creel brakes without putting the resetting mechanism in operation. Thus when the warper has come to a stop as the result of completion of the yarn mass on the beam, the operator may draw forward the lever 126, thus causing the resetting mechanism to remove the drag pressure from the cheeses and throw in the high speed drive. As soon as the threads are under tension, the operator again pulls the lever 126, thereby causing the creel brakes and the beam brake to be applied and the drive to be thrown out. As soon as the brakes have been applied, the operator actuates the means previously alluded to for preventing the brakes from being released. Or the operator may first actuate said means and then pull the lever 126 to set the brakes and throw out the drive. With either method the brakes stay in the applied position.

The threads joining the cheeses and the beam having been severed, the beam is removed in any convenient way, as for example, in the following manner: A crank is applied to the squared shaft 443 (Fig. 3), and rotated in the direction to raise the arms 1. Hooks attached to an overhead crane or block and tackle are then engaged with the peripherally grooved collars B^2 of the beam. The operator then disconnects the arms 1 in succession from the beam by holding back the latch 391 and raising the arm until it is clear of the trunnion bearing. The slot 416 is of sufficient length to permit the arm to be lifted free from the trunnion bearing. The crane is usually supported in such a way that when the beam is disengaged from the arms 1, the beam swings forwardly away from the warper. The beam may then be lowered onto a truck. The operator then disengages the hooks from the collars B^2; removes the trunnion bearings and places them on the trunnions of an empty beam; lifts one trunnion into position where the corresponding latch 391 will hold it suspended; then lifts the other trunnion into place; and then operates the crank on the squared shaft 443 to lower the beam onto the drum 7 and press the beam against the drum with the desired pressure. The creel having been loaded with a new set of cheeses, the threads from said cheeses are connected to the beam in the manner described in application Serial No. 190,501, after which the warper may be operated as hereinbefore described to fill the beam.

It will be noted that the trunnion bearings allow the necessary swiveling movement as the beam is doffed and a new beam substituted in the manner described.

It will be seen that the means for throwing in the high-speed driving mechanism is entirely distinct from the means for throwing in the low-speed driving mechanism. In warpers of the prior art, the low-speed and high-speed driving mechanisms have both been controlled by a single treadle, partial depression of which threw in the low speed, complete depression throwing in the high speed. It was thus possible through inadvertence to throw in the high speed when low speed was desired.

In case the operator should manipulate the high speed starting lever 126 while still depressing the treadle 88, no harm would be done, inasmuch as when the drive pulley 13 is clutched to the shaft 12 the ratchet wheel 77 rotates in the same direction as the drive pulley and the ratchet teeth would simply click past the yieldably mounted pawl 81.

It may be pointed out that the high-speed controlling cam 41 is not under direct control of the operator, but on the contrary is moved by the resetting mechanism, and hence is

always operated in a definite and proper manner and in proper sequence with reference to the operation of the creel brakes.

It will be understood that various changes may be made in the construction of the mechanisms herein disclosed and that certain features may be omitted without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim as my invention:

1. A high speed warper having, in combination, a friction drum, two pivoted arms to support a beam upon the drum, means to rotate the drum, said means including a friction clutch and a spring to actuate the clutch, and means actuated by pivotal movement of one of said arms for automatically controlling the force exerted by the spring.

2. A high-speed waper having, in combination, means to rotate a warp beam, said means including a friction clutch and a spring to actuate the clutch, and automatic means to control the force exerted by the spring in accordance with the size of the yarn mass on the beam.

3. A high-speed warper having, in combination, means to rotate a warp beam, and means to effect a gradual increase in the speed of the beam during the formation of the initial portion of the yarn mass on the beam, said last mentioned means being sensitive to increase in the diameter of the yarn mass.

4. A high-speed warper having, in combination, means to support a warp beam, a low-speed drive for the beam, a high-speed drive for the beam, and means for automatically adjusting the high-speed drive to wind a portion of the yarn mass on the beam at reduced speed.

5. A high-speed warper having, in combination, means to support a warp beam, a friction clutch through which the beam is driven, a spring for actuating the clutch, a cam movable while the initial portion of the yarn mass is being wound, and a member bearing against the cam and arranged to control the force of said spring.

6. A high-speed warper having, in combination, means to support a warp beam, a shaft for driving the beam, a friction clutch through which the shaft is driven, a rod extending axially of the shaft and connected to the clutch, a coiled spring surrounding the rod and tending to move the latter to throw in the clutch, a cam movable while the initial portion of the yarn mass on the beam is being wound, and a member bearing against the cam and arranged to press against the end of said rod.

7. A high-speed warper having, in combination, means to rotate a warp beam, said means including a friction clutch, automatic means acting gradually to reduce slippage of the clutch, and a speed-responsive device to control slippage of the clutch during the operation of said automatic means.

8. A high-speed warper having, in combination, means to rotate a warp beam, means responsive to increase in the size of the yarn mass on the beam to control the speed of the beam, and speed-responsive means also acting to control the speed of the beam during the operation of the first-mentioned speed controlling means.

9. A high-speed warper having, in combination, means to rotate a warp beam, means to effect a gradual increase in the speed of the beam during the formation of the initial portion of the yarn mass on the beam, said last mentioned means being sensitive to increase in the diameter of the yarn mass, and speed-responsive means also acting to control the speed of the beam during the formation of said initial portion of the yarn mass.

10. A high-speed warper having, in combination, means to support a warp beam, a shaft for driving the beam, a friction driving clutch comprising an element mounted on the shaft, a rod extending axially of the shaft and connected to the clutch, a coiled spring surrounding the rod and tending to move the latter to throw in the clutch, and a speed responsive governor driven by said shaft and arranged to exert force to move the rod in the direction to relieve the spring pressure on the clutch.

11. A high-speed warper having, in combination, means to support a warp beam, a shaft for driving the beam, a friction driving clutch comprising an element mounted on the shaft, a rod extending axially of the shaft and connected to the clutch, a coiled spring surrounding the rod and tending to move the latter to throw in the clutch, a speed-responsive governor driven by said shaft, a member through which the governor may exert force to move the rod in the direction to relieve the spring pressure on the clutch, a cam movable while the initial portion of the yarn mass on the beam is being wound, and a part bearing against the cam and arranged to adjust the position of said member.

12. A high-speed warper having, in combination, means to support a warp beam, a shaft for driving the beam, a friction driving clutch comprising an element mounted on the shaft, a rod connected to the clutch, a spring tending to move the rod to throw in the clutch, a speed responsive governor driven by said shaft, a member through which the governor may exert force to move the rod in the direction to relieve the spring pressure on the clutch, a cam movable while the initial portion of the yarn mass on the beam is being wound, and a part bearing against the cam and arranged to adjust the position of said member.

13. A winder having, in combination, a drum, a pivoted arm to support a receiving

yarn mass upon the drum, means to rotate the drum, the last mentioned means including a friction clutch and a spring to actuate the clutch, a cam attached to said arm, and means actuated by said cam for automatically increasing the force exerted by the spring as the the yarn mass grows.

14. A high-speed warper having, in combination, a friction drum, two pivoted arms to support a beam upon the drum, means to rotate the drum, the last mentioned means including a friction clutch and a spring to actuate the clutch, a cam attached to one of said arms, and means actuated by said cam for automatically controlling the force exerted by the spring.

15. A high-speed warper having, in combination, means including a friction drum for rotatably supporting a beam, a driver, a friction clutch to transmit power from the driver to the drum for rotating the latter at high speed and automatic means responsive to increase in the size of the yarn mass on the beam to control slippage in the clutch during acceleration of the beam in order properly to accelerate the beam at various stages of completion of the yarn mass.

16. A high-speed warper having, in combination, means to rotate a warp beam, said means including a friction clutch, and automatic means responsive to increase in the diameter of the yarn mass on the beam to control slippage in the clutch during acceleration of the beam in order properly to accelerate the beam at various stages of completion of the yarn mass.

17. A high-speed warper having, in combination, means to support a warp beam, a shaft for driving the beam, a friction driving clutch comprising an element mounted on the shaft, a rod extending axially of the shaft and connected to the clutch, a coiled spring surrounding the rod and tending to move the latter to throw in the clutch, a speed responsive governor driven by said shaft, a member through which the governor may exert force to move the rod in the direction to relieve the spring pressure on the clutch, a cam movable while the initial portion of the yarn mass on the beam is being wound, a part bearing against the cam and arranged to adjust the position of said member, a cam movable as the beam fills, and means operated by the last mentioned cam to increase the force of said spring.

18. A warper having, in combination, a supporting framework, a friction drum mounted in the framework for supporting a warp beam, arms pivoted to the framework to engage the trunnions of the beam, a brake for the friction drum, a cam fixed to one of said arms, and means operated by said cam for adjusting the brake.

19. A warper having, in combination, a supporting framework, a friction drum mounted in the framework for supporting a warp beam, arms pivoted to the framework for engaging the trunnions of the beam, a brake for the friction drum, a spring for actuating the brake, and connections between one of said arms and said spring for adjusting the tension of the latter.

20. A warper having, in combination, beam-rotating means, a drive shaft connected to the beam-rotating means, a drive pulley, means to connect the pulley to the drive shaft, a hand lever and connections controlling said connecting means, a train of reduction wheels between said pulley and the drive shaft, said train being enclosed within the pulley and a treadle for placing said train of reduction wheels in operation.

21. A warper having, in combination, beam-rotating means, a drive shaft connected to the beam-rotating means, a drive pulley, means to connect the pulley to the drive shaft, a hand lever and connections controlling said connecting means, a train of reduction wheels between said pulley and the drive shaft, said train being enclosed within the pulley and means independent of said hand lever for placing said train of reduction wheels in operation.

22. A warper having, in combination, means to support a warp beam, a shaft connected to drive the beam, a clutch through which the shaft is driven, a spring tending to throw in the clutch, a brake including a brake element mounted on the shaft and a spring tending to apply the brake, a rock shaft, two cams on said rock shaft, each for controlling one of said springs and arranged to release the springs alternately, and manipulative means connected to actuate said rock shaft.

23. A warper having, in combination, a supporting framework, means including a friction drum mounted in said framework for supporting a warp beam, a drive head located in the rear part of the supporting framework and approximately midway between the sides of the framework, and driving connections between the drive head and the friction drum.

24. A warper having, in combination, a supporting framework, means including a friction drum mounted in the forward portion of said framework for supporting a warp beam, a shaft mounted in the rear portion of said framework and connected to the drum, a drive pulley rotatably mounted on said shaft approximately midway between the sides of the framework, means to transmit power from the drive pulley to the shaft, said transmission means including devices permitting slippage during acceleration, means to throw said transmission means in and out of action, and a brake including a brake element fixed on said shaft.

25. A warper having, in combination, a main

frame, means to support a warp beam at the front of said frame, a shaft located at the rear of said frame and connected to drive the beam, a drive pulley mounted concentrically of the shaft approximately midway of the sides of the main frame, a clutch mounted on the shaft at one side of the pulley for transmitting power from the pulley to the shaft, a spring tending to throw in the clutch, a brake including a brake element mounted on the shaft at the same side of the pulley as the clutch, a spring tending to apply the brake, means to release said springs alternately, and means at the other side of the pulley to control the clutch-actuating spring.

26. A high-speed warper having, in combination, a supporting framework, means including a friction drum mounted in the forward portion of said framework for supporting a warp beam, a shaft mounted in the rear portion of said framework and connected to the drum, a drive drum rotatably mounted on said shaft approximately midway between the sides of the framework, a clutch mounted on the shaft at one side of said drive drum for transmitting power from said drive drum to the shaft, means for operating said clutch, a train of reduction wheels within the drive drum for transmitting power from the latter to the shaft, a treadle extending across the front of the warper beneath the beam and connected to throw said train of reduction wheels into and out of effective operation, and a brake mounted on said shaft.

27. A high-speed warper having, in combination, a supporting framework, means including a friction drum mounted in the forward portion of said framework for supporting a warp beam, a shaft mounted in the rear portion of said framework and connected to the drum, a drive drum rotatably mounted on said shaft approximately midway between the sides of the framework, a friction clutch mounted on the shaft at one side of said drive drum for transmitting power from said drive drum to the shaft, means for operating said clutch, a train of reduction wheels for transmitting power from the drive drum to the shaft, a treadle extending across the front of the warper beneath the beam and connected to throw said train of reduction wheels into and out of effective operation, and a brake for stopping the friction drum.

28. A high-speed warper having, in combination, a main frame, means to support a warp beam at the front of said frame, a shaft located at the rear of said frame and connected to drive the beam, a drive pulley mounted concentrically of the shaft approximately midway of the sides of the main frame, a clutch mounted on the shaft at one side of the pulley for transmitting power from the pulley to the shaft, a spring tending to throw in the clutch, a brake including a brake element mounted on the shaft, a spring tending to apply the brake, and means to release said springs alternately.

29. A high-speed warper having, in combination, a supporting framework, means including a friction drum mounted in the forward portion of said framework for supporting a warp beam, a shaft mounted in the rear portion of said framework and connected to the drum, a drive drum rotatably mounted on said shaft approximately midway between the sides of the framework, means to transmit power from the drive drum to the shaft, said transmission means including devices permitting slippage during acceleration, means to throw said transmission means in and out of action, and a train of reduction wheels within the drive drum for transmitting power from the latter to the shaft.

30. A high-speed warper having, in combination, a supporting framework, a friction drum mounted in the framework for supporting a warp beam, arms pivoted to the framework to engage the trunnions of the beams, means to rotate the drum, said means including a friction clutch, and means sensitive to changes in the diameter of the yarn mass on the beam for adjusting said clutch to decrease slippage in the clutch as the yarn mass increases in diameter, said adjusting means including a cam connected to one of the beam-supporting arms, and a lever engaging said cam.

31. A high-speed warper having, in combination, means to support a warp beam, means to rotate the beam, and means to effect a gradual increase in the speed of the beam during the formation of the initial portion of the yarn mass on the beam, said means including a cam, stops to determine the initial and final positions of the cam, and a part yieldingly connected to the beam-supporting means for swinging said cam.

32. A high-speed warper having, in combination, means to rotate a warp beam, said means including a friction clutch, and means sensitive to changes in the diameter of the yarn mass on the beam for adjusting said clutch to decrease slippage in the clutch as the yarn mass increases in diameter.

33. A high-speed warping apparatus having, in combination, a drive for a warp beam, a brake to stop the beam, a rock shaft and connections for controlling the drive and the brake, a warper clock arranged to close an electric circuit, a detector for the thread of a supply yarn mass, said detector being arranged to close an electric circuit, and a switch arranged to be actuated by said rock shaft, which switch controls said circuits, to open said circuits when the warper is stopped.

34. The method of rapidly filling a section beam which consists in so controlling the speed of the beam during the winding of the initial portion of the yarn mass that objectionable slippage between the yarn mass and

the driving drum shall not occur upon sudden stoppage of the drum, and (after the winding of such initial portion) completing the winding at a higher speed.

35. The method of rapidly filling a section beam which consists in so controlling the speed of the beam during the winding of the initial portion of the yarn mass that objectionable slippage between the yarn mass and the driving drum shall not occur upon sudden stoppage of the drum, and (after the winding of such initial portion) completing the winding at a higher speed, said initial portion being wound at a gradually increasing speed.

36. The method of rapidly filling a section beam which consists in winding yarn upon the beam at relatively low speed until after the yarn mass on the beam has attained sufficient thickness to resist the tendency to slippage between the yarn mass and the driving drum when coming to a stop from normal high speed, and thereafter completing the winding at such normal high speed.

37. The method of rapidly filling a section beam which consists in winding yarn upon the beam at relatively low and gradually increasing speed until after the yarn mass on the beam has attained sufficient thickness to resist the tendency to slippage between the yarn mass and the driving drum when coming to a stop from normal high speed, and thereafter completing the winding at such normal high speed.

In testimony whereof, I have hereunto set my hand.

HOWARD D. COLMAN.

CERTIFICATE OF CORRECTION.

Patent No. 1,741,757. Granted December 31, 1929, to

HOWARD D. COLMAN.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 8, line 34, for the word "strip" read "trip"; page 11, line 124, claim 33, strike out the words "which switch controls said circuits,"; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 28th day of January, A. D. 1930.

M. J. Moore,
Acting Commissioner of Patents.

(Seal)